Bioresources and Environment 2025, 3(1) 1-13.

Content list available at BioEnv

Bioresources and Environment

Journal homepage: www.bioenvuitm.com

Heavy Metal Concentrations in Street Dust from Residential and Industrial Areas at Mukim Hulu Kinta Perak

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Received August 19, 2024, Accepted in revised form October 21, 2024
Available online February 27, 2025

ABSTRACT. Street dust forms due to the interaction of the atmosphere, lithosphere (pedosphere), and anthroposphere and can be regarded as an index of the environmental condition in urban areas because it may affect ecosystems and human health. This research aimed to ascertain the concentration of heavy metals (cadmium, lead, zinc, and copper) in street dust from residential and industrial zones; to compare the concentrations of these metals between the two areas; and to assess the human health risks associated with street dust exposure to heavy metals in Mukim Hulu Kinta, Perak. Seventy-two street dust samples were prepared by wet acid digestion method and analysed using the Atomic Absorption Spectroscopy for the assessment of copper, cadmium, zinc, and lead concentrations. The results indicated a declining trend in metal concentrations of street dust, averaged from residential and industrial regions, in the following order: zinc > copper > lead > cadmium. Statistical study employing an independent t-test revealed a significant difference in Pb levels across residential and industrial zones ($p = 0.004$, $t = -1.562$, $df = 70$). No significant changes are observed in the levels of copper, cadmium, and zinc between the locations. All hazard quotients demonstrated that the values for copper, cadmium, zinc, and lead were below one, which is an acceptable threshold for human safety. Consequently, the residential and industrial zones demonstrate a safe concentration of heavy metals in street dust for the populace. To prevent enduring adverse consequences, Ipoh's expanding industrial and residential development underscores the imperative for ongoing air pollution management in the urban setting.

Key words: Street dust, Heavy metal, Health Risk Assessment

INTRODUCTION

Street dust forms as a result of the interaction of the atmosphere, lithosphere (pedosphere) and anthroposphere and can be regarded as an index of the environmental condition in urban areas. Heavy metals in street dust are considered air pollutants that are harmful to humans and other living organisms (Aguilera et al., 2021). A study by Nawrot et al. (2020) stated that heavy metal contaminants are potentially toxic when absorbed into the human body in higher concentrations that can lead to chronic effects depending on the routes of exposure (i.e., inhalation, ingestion, and absorption). These contaminants are deemed hazardous when individuals are subjected to direct contact and inhalation, leading to potential bioaccumulation within the human body (Briffa et al., 2020). In addition, these pollutants have been linked to a variety of illnesses, including kidney and bone damage, developmental and neurobehavioral abnormalities, high blood pressure, and suspected lung cancer (Xie et al., 2010). These pollutants are derived from different activities such as industrial activities (i.e., waste incineration) and road traffic (i.e., vehicles emission).

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The principal sources of heavy metals such as cadmium (Cd), copper (Cu), lead (Pb), and zinc (Zn) include automotive exhaust emissions and the wear of various vehicle components, including tires and brake discs, in addition to paved roads, overhead power lines, and other sources utilized by trams, trolleybuses, and trains. The concentration of heavy metals in street dust are significantly affected by proximity to industrial activities, in addition to intensity of industrial activities. Industries frequently emit airborne pollutants containing particles of heavy metals into the surrounding environment which can travel through the air and settle on surfaces, including roads, pavements, and other outdoor areas, where they become street dust. Previous studies have shown that urban street dust is polluted to varying degrees by heavy metals (Li et al., 2017; Xu et al., 2018; Ismail et al., 2019; Chen et al., 2022).

The evaluation of contamination level and risk associated with heavy metals in road dust have attracted much attention in recent years due to their concerning impacts. Within the KL metropolitan area, the presence of metal pollutants in street dust varied depending on the traffic load and human capacity (Ismail et al., 2019). Additionally, concentrations of heavy metals in road shoulder dust along the East-West highway were found to be in the order of Mn>Pb>Zn>Cu>Cd (Aweng et al., 2020). The contamination of roadway dust with heavy metals is infrequently addressed in Malaysia, particularly in areas distant from the Klang Valley. The levels of metals in street dust vary from region to region, depending on land use, population density, and traffic density (Lin et al., 2023). Due to the numerous industrial parks and high traffic density in Ipoh City, metals may be released into the environment, resulting in increasing metal pollution, and that may have a potential impact on the ecological environment and human health. This research aimed to examine the concentrations of cadmium, copper, lead, and zinc in street dust from residential and industrial districts, and to assess the human health risks associated with inhalation exposure to street dust in Mukim Hulu Kinta, Perak. The study will enable the assessment of pollutant prevalence that endangers the health of residents in medium-sized cities.

METHODOLOGY

Sample collection

Mukim Hulu Kinta is located within the Kinta District, with an approximate area of 1,305 km^2. The entire Mukim Hulu Kinta is under the administration of Ipoh City Council. This study was executed in September 2022 in residential and industrial zones, within a 1 km radius (Figure 1) at each sampling location from the road surfaces following three consecutive sunny days. The geographical coordinates of each site were recorded. A total of 72 street dust samples were swept using brush and scoop (Wahab et al., 2012). Approximately 100 g of dust were deposited in polyethylene plastic bags, air-dried at room temperature for 24 hours (Saufi, 2010), and sieved through a 1-mm nylon mesh to remove waste materials (Shabbaj et al., 2018) and small stones. Next, all the samples were transferred to the Environmental Instrumentation Laboratory in the Faculty of Health Sciences, UiTM Puncak Alam for further analysis.

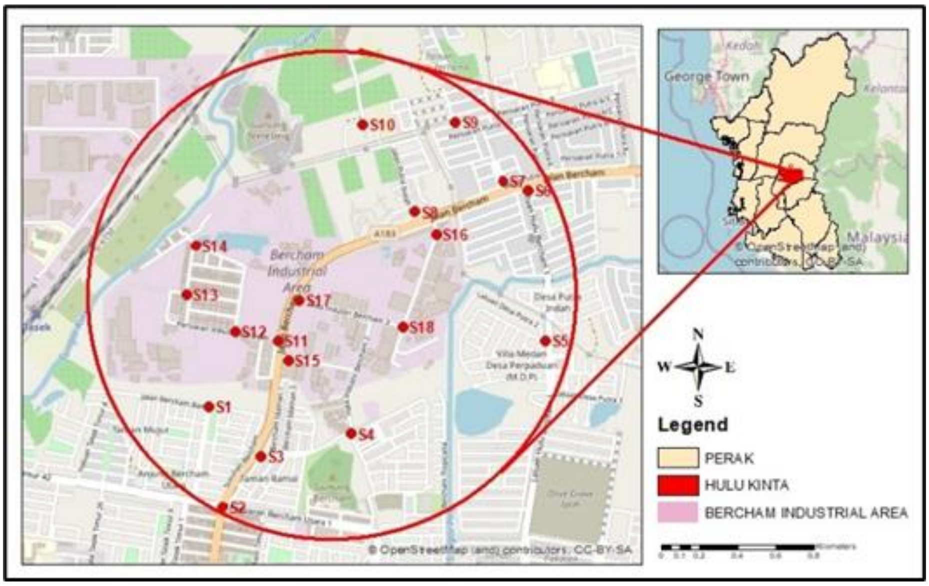

Figure 1. Street dust sampling sites in Mukim Hulu Kinta Perak.

Sample and data analysis

The Wet Digestion Method was employed for the preparation of samples in the examination of heavy metals. Approximately 1 g of each sample was subjected to digestion with 20 mL of aqua regia, comprising HNO_3 and HCl in a 1:3 ratio, along with 2.5 mL of hydrofluoric acid (HF) in a glass Pyrex beaker, as outlined by Tay & Zakaria (2021). The hot plate was set at 100°C to heat the mixture to a virtually dry condition after letting it rest overnight. The digested solutions were filtered through No. 42 Whatman filter paper using deionised water, diluted to 100 mL, and stored at 4°C in pre-cleaned polyethylene bottles until instrumental analysis (Suvetha et al., 2022). HNO_3 (1%) was prepared as the diluent for all standard solutions: ×10, ×100, and ×1000. Concentrations of Cd, Cu, Pb and Zn in standard solutions and samples were determined using an Atomic Absorption Spectrometer (Perkin Elmer Analyst 800). The samples were diluted when the heavy metals concentration was greater than standard. Independent t-test were performed using IBM Statistical Package for the Social Sciences or SPSS version 22.0. The significance was set at $\alpha = 0.05$ in the statistical analysis.

Health risk assessment

Health risk assessment models were used to quantify the health risk (carcinogenic and non-carcinogenic) for children and adults exposed to heavy metals in street dust. The estimated daily intake (EDI, mg/kg/day) and lifetime average daily dose (LADD, mg/kg/day) for all target heavy metals were estimated using Equation 1 and 2, adopted from USEPA Exposure Handbook (2011):

$$EDIinh = \frac{C \times InhR \times EF \times ED}{BW \times AT} \quad \text{Equation 1}$$

$$LADD = \frac{C \times CR \times EF \times ED}{PEF \times BW \times ATcan} \quad \text{Equation 2}$$

where the EDIinh is the estimated daily intake (mg/kg/day) of metals through inhalation exposure for non-carcinogenic metals and LADD is the lifetime average daily dose exposure to metals calculated for cancer risk. Hazard Quotient (HQ) was used to determine the risk from non-carcinogenic consequences of heavy metals (Equation 3) while the incremental lifetime cancer risk (ILCR) was calculated for carcinogenic elements (Equation 4).

$$HQ = \frac{EDIinh}{RfD} \quad \text{Equation 3}$$

$$ILCR = LADD \times CSF \quad \text{Equation 4}$$

This study's associated reference dose (RfD) to calculate the hazard quotient (HQ) are shown in Table 1 while exposure variables that have been identified for reference populations are given in Table 2. If the value of HQ < 1, there is no considerable danger of non-carcinogenic consequences. Hazard index (HI) values show the sum of the values of the HQ for all metals through inhalation pathways. If the value of HQ or HI is more than one, there is a possibility that non-carcinogenic consequences will occur, with the likelihood increasing as the value of HQ or HI grows (US EPA, 2001). The LADD is multiplied by the CSF to obtain the incremental lifetime cancer risk. An ILCR value between 10^{-6} and 10^{-4} denotes potential risk while an ILCR $\leq 10^{-6}$ represents high potential health risk (Aguilera et al., 2021).

Table 1. Reference doses (RfD) and cancer slope factor (CSF) for each route of exposure (US EPA, 2001)

Heavy metals	**Inhalation RfD**	**Inhalation CSF**
Cd	1×10^{-3}	6.30
Cu	4.0×10^{-2}	
Pb	3.5×10^{-2}	4.2×10^{-2}
Zn	3×10^{-1}	

Table 2. Exposure factors of reference populations for human health risk assessment

Factor	**Parameter and units**	**Value**		**Reference**
		Child	**Adult**	
InhR	Inhalation rate (m^3/day)	7.6	20	Li et al., (2013)
PEF	Particle emission factor (m^3/kg)	1.36×10^9	1.36×10^9	USEPA (2001)
ED	Exposure duration (years)	6	24	USEPA (2001)
EF	Frequency of exposure (day/year)	180	180	Aguilera et al., (2021)
AT	Average time non-carcinogen (days)	ED*365	ED*365	USEPA (2001)
ATcan	Average time carcinogen (days)	70*365	70*365	USEPA (2001)
BW	Body Weight (kg)	15	70	USEPA (2001)

RESULTS AND DISCUSSION

Heavy Metal Concentrations in Street Dust

The mean concentrations of heavy metals in street dust collected from Mukim Hulu Kinta are shown in Table 3. The mean concentrations of heavy metal in descending order were Zn > Cu > Pb > Cd. The mean concentrations were 126.3, 64.31, 8.30, and 3.21 mg/kg for Zn, Cu, Pb and Cd, respectively, indicating that the metal pollution in street dusts might derive mainly from anthropogenic sources.

Table 3. Metal concentrations in street dust (n = 72 samples)

Heavy Metals	Min	Max	Mean (SD) mg/kg
Zn	2.80	370.00	126.31 (98.16)
Cu	0.28	625.00	64.31 (123.40)
Pb	43.90	102.60	8.30 (22.37)
Cd	2.10	5.40	3.21 (0.79)

Note: SD = Standard Deviation

Figure 2 illustrates the average concentration of Cd from the 18 sampling sites. The maximum concentration of Cd was measured at 4.00 mg/kg in S4 (Laluan Hulu Bercham Utara 7). The minimum concentration of Cd was observed at S6 (Laluan Hulu Bercham 1), measuring approximately 2.58 mg/kg. The minimum Cd concentration was obtained from the sample location in the residential zone characterized by low traffic volume. Conversely, the largest concentration of Cd was identified within the vicinity of industrial activities. The cadmium content was the lowest among all analyzed metals. A comparable trend was observed across all 15 study sites in the Kuala Lumpur metropolitan area, revealing that Cd exhibited the lowest mean concentration among the pollutants in the study area (Ismail et al., 2019). The geochemical baseline concentration of Cd utilized to assess the contamination status was 0.80 mg/kg (Dytłow & Górka-Kostrubiec, 2021). This investigation found that the concentration of Cd at all sampling locations exceeded background levels. Comparable patterns were seen for Cd in street dust, with concentrations above the geochemical background at 62 test sites in Lublin City.

The concentration of Cu was highest in S18 (Laluan Industri Putra 1) at 277.35 mg/kg in comparison to other locations. The minimum concentration of Cu was observed in S5 (Laluan Desa Putra 1) at around 13.10 mg/kg. A significant disparity in copper levels exists between the S5 and S18 street dust samples. S18 is situated at street intersections and within industrial zones, serving as an access point for big tankers, trucks, and lorries entering the industrial sectors. S5 is situated in a residential zone characterized by minimal traffic and low vehicle density. At around 80% of the sampling sites, copper concentrations surpassed the background value of 17.8 mg/kg (Khodadadi et al., 2022).

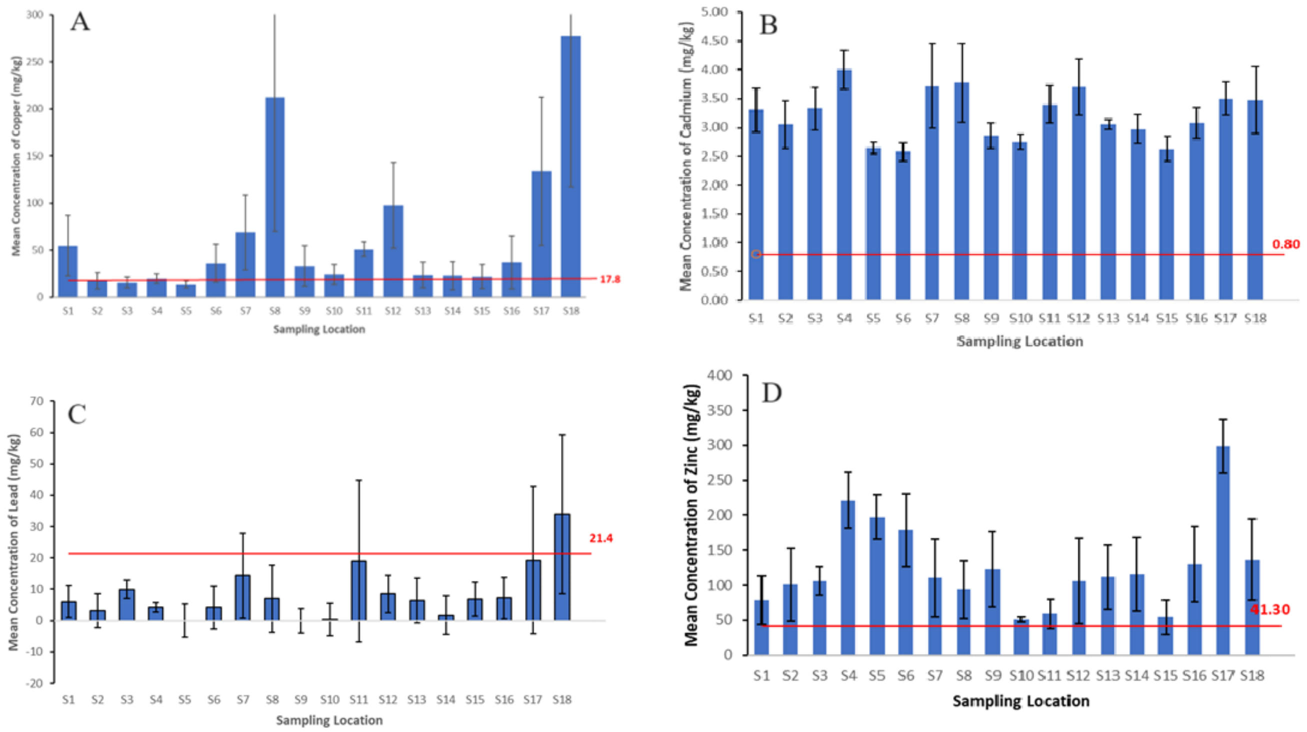

Figure 2. Mean concentration of A) copper; B) cadmium; C) lead and D) zinc in mg/kg at sampling locations. Note: Red line indicating the corresponding background value for each element respectively.

The concentration of Pb at S18 (Laluan Industri Putra 1) was 33.93 mg/kg, exceeding that of the other locations. The locality of site S18, which is encircled by residential areas and industrial activity, exacerbated by the active traffic load on the road, is the cause (Ismail et al., 2019). Lead (Pb) was undetectable at S5 (Laluan Desa Putra 1) and S9 (Persiaran Putera 9) mostly because of their distance from intersections and low traffic density. Consequently, these sampling stations exhibited low Pb levels, potentially attributable to traffic load and the influence of surrounding anthropogenic activities (Saufi, 2010). This study indicates that automotive emissions are the sole contributor to the lead levels. Moreover, prior research has shown that lead (Pb) is mostly generated by anthropogenic sources, predominantly from vehicular emissions (Fan et al., 2022). The findings contradict a prior study that indicated significant lead pollution in Gorgon City, where over 90% of street dust samples were near background levels (Khodadadi et al., 2022). This conclusion arises from the city's advanced development and its status as the provincial capital, where the lead (Pb) source is linked to both anthropogenic factors such as industrial activities, vehicular emissions, coal combustion, and construction, as well as the natural lithological composition of local soils.

The maximum concentration of Zn was found at 298.75 mg/kg from S17 (Hala Industri Bercham 2). In contrast, the minimum concentration of Zn was 51.38 mg/kg from S10 (Jalan Bandar Baru Putra). S17 is situated adjacent to the primary thoroughfare Jalan Bercham, characterized by high traffic congestion, whereas S10 is positioned in an area with moderate traffic intensity. Zinc has been identified as a major contaminant in street dust in Kuala Lumpur, characterized by high traffic density (Ismail et al., 2019). The origin of Zn is believed to stem from the abrasion wear of tires, lubricating oil, and vehicle engines (Bourliva et al., 2017). Zinc oxide is incorporated in tire manufacturing and serves as an activator in the vulcanization process (Shabbaj et al., 2018). All samples exhibited Zn levels exceeding the street dust background limits established in a prior study, which reported 41.3 mg/kg (Dytłow & Górka-Kostrubiec, 2021). A comparable outcome was also demonstrated in a study conducted in the Shijiazhuang metropolitan area of China (Fan et al., 2022).

Comparison of heavy metal concentrations in street dust from residential and industrial area.

Samples from industrial and residential regions exhibit the presence of Cu, Cd, and Zn. Nonetheless, Pb was undetected at S5 (Laluan Desa Putra 1) and S9 (Persiaran Putera 9). Table 4 displays the concentrations of Pb, Cu, Zn, and Cd in street dust from residential and industrial locations, indicating the minimum (Min), maximum (Max), mean, and standard deviation (SD). The mean metal levels in street dust exhibit a declining tendency from residential to industrial regions as follows: Zn surpasses Cu, which exceeds Pb, followed by Cd. The mean concentration of heavy metals in street dust samples from the Kuala Lumpur Metropolitan Area exhibited a declining tendency in the following order: Zn > Cu > Pb > Cd (Ismail et al., 2019). The highest concentration of metal is detected for Zn, with a mean of 126.20 mg/kg, whilst the lowest mean concentration is for Cd, at 3.20 mg/kg, in the residential area. In the industrial region, the concentration of Zn is documented to exceed that of Cd, with mean concentrations of 126.45 mg/kg and 3.23 mg/kg, respectively. It may be stated that the mean concentrations of all metals in the industrial area exceeded those in the residential area.

Vehicle emissions and industrial production are closely linked to heavy metal enrichment (Chen et al., 2022). The severity of metal pollution in relation to land use has been documented as industrial > commercial > residential > greenspace (Madadi et al., 2022). Residential zones generally exhibit reduced metal concentrations in roadway dust owing to diminished traffic density and fewer heavy vehicles (Li et al., 2017). The concentration of Zn was markedly elevated in comparison to other metals present in street dust from both industrial and residential regions. Sources of Zn emissions included lubricant oil, vehicle engines, and tyre abrasion wear (Bourliva et al., 2017).

Table 4. Heavy metals concentration (mg/kg) in street dust from residential and industrial areas (n = 72 samples)

Sampling Location		**Cd**	**Cu**	**Pb**	**Zn**
Residential	Min	2.10	0.30	*BDL	2.80
	Max	5.40	605.00	40.50	285.00
	Mean	3.20	49.35	4.65	126.20
	SD	0.87	103.50	13.07	89.94
Industrial	Min	2.20	0.28	*BDL	16.60
	Max	4.70	625.00	102.60	370.00
	Mean	3.23	83.01	12.86	126.45
	SD	0.69	144.04	29.88	109.05

*Note: BDL = Below Detection Limit

Previous investigations have demonstrated metal concentrations in street dust samples from industrial areas in India and China, ranked as follows: Zn > Pb > Cu > Cd (Roy, 2022; Chen et al., 2022). Similarly, a case study conducted by Amjadian et al. (2018) showed elevated zinc concentrations in the Northern industrial zone of Erbil, Iraq. The highest concentrations of Pb were observed in Baogang Park, located in the West Industrial Park of Baotou city (Han et al., 2017). Han et al. (2017) conducted a study that indicated the greatest concentrations of Pb were found in the industrial zone.

The concentration of heavy metals in this investigation revealed comparable levels of Cu, Cd, and Zn between residential and industrial areas, with no significant differences identified by T-test statistics. Only Pb levels exhibited a statistically significant difference between residential and industrial locations ($p = 0.004$, $t = -1.562$, $df = 70$). The independent t-test comparing heavy metal concentrations from residential and industrial locations is presented in Table 5.

Table 5. Independent t-test between heavy metal concentrations from residential and industrial areas

Metals	**F**	**t**	**df**	***Sig. p*-value***
Cd	2.471	-0.133	70	0.120
Cu	2.399	-1. 153	70	0.126
Pb	8.671	-1.562	70	*0.004
Zn	2.456	-0.011	70	0.122

* significant value at $p < 0.05$

The resemblance in metal concentrations between industrial and residential zones in this study may be ascribed to the proximity of the industrial sector to the residential region, resulting in substantial traffic flow in both locales, along with the types of vehicles present. In contrast, a prior study by Huang et al. (2022) revealed no substantial disparity in heavy metal concentrations between residential and industrial zones in the Pearl River Delta, potentially due to the differing types and intensities of human activity in each region.

In this study, the residential area is less than 1 km in radius away from the industrial area. Street dust samples on the roads may have been polluted by the industrial activities. It's possible that some neighbouring residential street dust was polluted by the airborne lead from industrial sources. Due to the considerable ecological and health concerns in the research region, it is possible that some adjacent residential street dust was polluted by airborne Pb from industrial sources. It briefly settles on outdoor surfaces before being readily re-suspended into the air by wind or vehicles (Ismail et al., 2019). In addition, the heavy metal concentrations in the dust occurred at the residential area may originate from the higher vehicular traffic. The roads in residential areas were used for lorries, trucks and tractors as an entrance and exit. Therefore, this study may conclude that the traffic and industry activities exert influence on the Pb levels. Similar study by Amjadian et al., (2018) revealed the high Pb contamination in street dusts, particularly in high traffic and industrial zones of the city in Erbil metropolis. Thus, the traffic density was the factor that most influenced the values of the pollution indexes.

Human Health Risk Assessment

Inhalation exposure may occur by inhaling air polluted with dust particles. Both adults and children may be exposed through inhalation during various outdoor and indoor activities. The EDI and LADD were computed using average metal concentrations in the residential zone. The non-cancer and cancer risks associated with exposure to all metals in street dust do not present a hazard to adults and children in the study areas. The outcomes of the risk assessment are presented in Table 6. This study indicated that the inhalation of dust particles is regarded as a non-carcinogenic risk, consistent with a prior finding (Khodadadi et al., 2022). As shown in Table 6, the highest EDI_{inh} value is 2.32×10^{-8} for Zn, while the lowest is 3.33×10^{-10} for Cd. The doses calculated for each metal and exposure pathway were subsequently divided by the corresponding RfD (mg/kg/day) to obtain hazard quotient (HQ). Thus, the HQ < 1 are negligible non-carcinogenic risk for both adults and children. The RfD inhalation for Cu was 0.04 mg/kg/day, Cd (0.001 mg/kg/day), Zn (0.30 mg/kg/day), and Pb (0.035 mg/kg/day). The orders of non-cancer hazard quotient of heavy metals for adults decreased in the order of Zn > Cu > Pb > Cd, similar to that for children. Instead, Ma and Singhirunnusorn (2012) reported non-cancer hazard quotient of heavy metals in the following order: Cd > Pb > Cu > Zn in children and Pb > Cd > Cu > Zn in adults. Similar order of hazard index values (Pb > Cu > Zn > Cd) was reported for urban street dust exposure in Madrid (Delgado-Iniesta et al., 2022), while a decreasing trend of Cu > Cd > Zn was reported for typical industrial exposure in Wuhan City (Chen et al., 2022). The differences in these findings are attributed to the type of industrial activities taking place with influences by local topography and weather patterns.

Table 6. Non-cancer and cancer risk from metal exposure via inhalation pathway in the residential area (mg/kg/day)

Metal	Cd	Cu	Pb	Zn
Mean (mg/kg)	3.20	49.35	4.65	126.20
Children				
EDI_{inh}	5.90×10^{-10}	1.18×10^{-8}	1.52×10^{-9}	2.32×10^{-8}
LADD	5.06×10^{-11}		1.31×10^{-10}	
HQ_{inh}	5.06×10^{-8}	2.51×10^{-8}	3.74×10^{-9}	6.63×10^{-9}
ILCR	3.19×10^{-10}		5.5×10^{-12}	
Adult				
EDI_{inh}	3.33×10^{-10}	6.66×10^{-9}	8.60×10^{-10}	1.31×10^{-8}
LADD	1.14×10^{-10}		2.95×10^{-10}	
HQ_{inh}	1.14×10^{-7}	5.67×10^{-8}	8.43×10^{-9}	1.50×10^{-8}
ILCR	7.18×10^{-10}		1.19×10^{-11}	

Bourliva et al. (2017) revealed that no adverse health effects are expected due to exposure if the calculated HQ is less than 1. However, the HQ value greater than 1 indicates the possibility of adverse health effects. For children, the HQ values for Cd, Cu, Pb, and Zn contributed by inhalation were 5.06×10^{-8}, 2.51×10^{-8}, 3.74×10^{-9} and 6.63×10^{-9}. Meanwhile, the HQ values for adults were 1.14×10^{-7} (Cd), 5.67×10^{-8} (Cu), 8.43×10^{-9} (Pb) and 1.50×10^{-8} (Zn).

This analysis indicates that the hazard quotient for all heavy metals is below one, which is an acceptable threshold for human safety. Comparable findings have been observed in other regions, including Jeddah, where the non-carcinogenic risk associated with heavy metals was assessed to be below the acceptable thresholds for both children and adults (Suvetha et al., 2022). The ILCR values for inhalation exposure for Cd and Pb is 3.19×10^{-10} and 5.5×10^{-12} for children and 7.18×10^{-10} and 1.19×10^{-11} for adults, respectively. Therefore, the findings of the health risk assessment revealed that the there was no cancer risk to both children and adults in Mukim Hulu Kinta. Similar results were obtained in previous studies of exposure to trace metals in street dust in Maha Sarakham City (Ma & Singhirunnusorn, 2012), Nanjing, China (Li et al., 2013), and Mexico City (Aguilera et al., 2021).

CONCLUSION

This study's chemical tests of roadway dust yield important data regarding the quantity of heavy metals in Mukim Hulu Kinta. According to the findings of the metal contamination assessment based on contamination degree and integrated pollution index (Suryawanshi et al., 2016), street dust is predominantly contaminated by Zn, Cd, and Pb. Street dust from industrial districts may exhibit elevated levels of heavy metal pollution, whereas street dust from residential zones also demonstrates considerable metal contamination. The non-cancer hazard index rankings of metals for adults were Zn > Cu > Pb > Cd, mirroring the pattern observed for children. Both children and adults may endure the carcinogenic and non-carcinogenic risks posed by heavy metals in urban road dust, as all assessed risk values remained within the tolerable threshold for humans. The count of cars was not conducted in this investigation to determine the contamination component of road dust. Furthermore, the specific manufacturing processes and activities inside the industrial region were not delineated, as this study concentrated solely on comparing heavy metal concentrations between residential and industrial zones. To prevent enduring adverse consequences from the increasing industrial and residential developments, continuous air pollution management in metropolitan areas is essential. Individuals residing in major metropolitan areas are most affected by air pollution. Government measures are necessary for emission reduction, a program to control street dust, citizen cleaning activities, and educational campaigns regarding potential health risks associated with exposure to street dust.

ACKNOWLEDGEMENTS

The researchers would like to acknowledge the laboratory personnel from the Environmental Analytical Laboratory, Faculty of Health Sciences, UiTM Puncak Alam for valuable technical input.

AUTHOR CONTRIBUTIONS

Nurhafidah Mohamad Ariff is responsible for data collection, analysis and preparation of the original draft. **Shantakumari Rajan** is responsible for the research idea and design, editing, checking language and grammar.

FUNDINGS

This research did not receive any financial funding.

DATA AVAILABILITY

Not applicable.

COMPETING INTEREST

The authors declare that there are no competing interests.

COMPLIANCE OF ETHICAL STANDARDS

Not applicable.

SUPPLEMENTARY MATERIAL

Not applicable.

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